SECTION 15950

TESTING, ADJUSTING, AND BALANCING

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LANL MASTER CONSTRUCTION SPECIFICATION

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the ESM Mechanical POC.

This document complies with 10CFR830 and is suitable for use with all safety-related systems including ML-1, ML-2, safety class, and safety significant. When used for safety systems, variance or modification requires an independent review of the changes per FWO-DO-602, Technical Review, or equivalent.

NOTE: Contact SUP-8, (SCOTT HAVEMANN) 667-5244, Procurement Group, to utilize existing contract with a certified TAB agency.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within “stars” during editing.

Specification developed for ML-3 /ML-4 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

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PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements of Contractor, LANL, and LANL retained TAB Agency.

B. TAB of [air], [hydronics], [steam], [and] [refrigerating] systems.

C. [Sound and vibration measurements of equipment operating conditions.]

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balance Bureau.

C. TAB: Testing, Adjusting, and Balancing.

1.3 LANL PERFORMED WORK

A. TAB will be performed by an independent AABC or NEBB-certified TAB Agency, contracted and directed by LANL under a separate contract.

1.4 SUBMITTALS

A. TAB Agency shall submit the following to the LANL Project Leader in accordance with Section 01330, Submittal Procedures:

1. Date of expiration of AABC or NEBB certification (prior to starting work).

2. TAB instruments that are to be used and calibration dates per AABC or NEBB requirements (prior to starting work).

3. Final test reports that are signed and stamped by a AABC or NEBB TAB Supervisor on the latest edition of approved AABC or NEBB Report Forms.

1.5 QUALITY ASSURANCE

A. TAB Agency: Perform Work in accordance with the latest edition of AABC or NEBB procedural standards for TAB of environmental systems.

B. A LANL representative may witness all or portions of the TAB Agencies Work.

PART 2 PRODUCT

2.1 INSTRUMENTS

A. The TAB Agency shall furnish instruments required for testing, adjusting, and balancing.

B. Instruments used for measurements shall meet AABC or NEBB-specified accuracy and calibration histories, and shall be available for spot-checking by LANL Construction Inspector during testing.

PART 3 EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. Provide window in project schedule for completion of TAB services prior to final inspection of project.

B. Have mechanical, controls, structural and related electrical systems complete and operable before notifying LANL Construction Inspector that project is ready for TAB Agency services and the requirements of 3.1 have been met. Advance written notice of not less than 15 calendar days is required.

C. Complete operational readiness prior to commencement of TAB services. Verify the following:

1. Doors, windows and ceilings are installed.

2. Systems are started and operating in safe and normal condition.

3. Temperature control systems are installed complete and operating. Testing and programming of all system components and the overall system has been completed and test reports accepted by the LANL Construction Inspector.

4. Proper thermal overload protection is in place for electrical equipment.

5. Construction filters have been replaced and the final filters are clean and in-place.

6. Duct systems are clean of debris.

7. Fans are rotating correctly.

8. Fire, smoke, and volume dampers are in place and open.

9. Air coil fins are cleaned and combed.

10. Access doors are closed and duct end caps are in place.

11. Air outlets and inlets are installed and connected.

12. Duct and piping supports are installed.

13. Duct systems are leak and pressure tested and test reports accepted by LANL Construction Inspector.

14. Hydronic systems are leak tested and test reports accepted by LANL Construction Inspector.

15. Hydronic systems are flushed, filled and vented.

16. Refrigerant systems are leak tested and test reports accepted by LANL Construction Inspector.

17. Pumps are rotating correctly.

18. Start-up screens from pump suction diffusers are removed.

19. Proper strainer baskets are clean and in place.

20. Service and balance valves are open.

21. Pressure gauges, temperature gauges, test fittings, etc., are installed.

D. Put HVAC systems and equipment into full operation and continue operation during times of testing and balancing.

1. Do not operate equipment until properly lubricated and brought into manufacturer's specified operating conditions.

E. Provide labor and materials to make any change in sheaves, belts, and dampers, required for correct balance as requested by the TAB Agency.

F. Provide labor, i.e., remove and reinstall ceiling tiles, etc., to access concealed equipment as requested by TAB Agency.

G. After TAB Agency is notified and TAB work started, should system(s) be found to not be in readiness or a dispute occurs as to readiness of system(s), the Contract Administrator may require a joint inspection be made by representatives of LANL, the TAB Agency and the Contractor.

1. Should inspection reveal TAB services notification to have been premature, costs of work previously accomplished by TAB Agency shall be paid for by the Contractor.

2. Such items as are not ready for TAB services shall be completed and placed in operational readiness by Contractor, and TAB services shall again be scheduled.

3.2 LANL RESPONSIBILITIES

A. Provide TAB Agency with Contract Drawings, approved submittal data, specifications and supplements required for TAB Agency to accomplish review, inspection and TAB services outlined in this specification.

B. Notify TAB Agency within 48 hours of receipt of written notification from Contractor that system(s) will be ready for testing, adjusting and balancing.

3.3 TAB AGENCY RESPONSIBILITIES

A. GENERAL

1. Review, inspect, test, adjust and balance systems, as outlined in this Section.

2. Promptly report to LANL Construction Inspector any conditions that prevent system balancing.

3. Cooperate with Contractor but do not instruct or direct Contractor in any of the work, but make such reports as are necessary directly to LANL Construction Inspector.

4. Do not provide any construction labor or materials to modify systems.

B. TOLERANCES

1. Air Handling Systems: Adjust to within plus or minus 10 percent of design flow rates.

2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design flow rates to space. Adjusts outlets and inlets in space to within plus or minus 10 percent of design flow rates.

3. Hydronic Systems: Adjust to within plus or minus 10 percent of design flow rates.

C. ADJUSTING

1. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

2. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

3. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

D. AIR SYSTEM PROCEDURE

1. Adjust air handling and distributions systems to obtain required or design supply, return and exhaust airflow rates.

2. Make airflow rate measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

3. Measure airflow rates at air inlets and outlets.

4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

5. Use volume control devices to regulate airflow rates only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

6. Vary total system airflow rates by adjustment of fan speeds. Vary branch airflow rates by damper regulation

7. Provide system schematic with design and actual airflow rates recorded at each outlet or inlet.

8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

9. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Check dampers for proper operation.

10. Check leakage across outside air, return air, and exhaust dampers.

11. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

12. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately [0.05] inches positive static pressure [near building entries] [in clean rooms] [ ].

13. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

14. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.

15. On fan powered VAV boxes, adjust airflow switches for proper operation.

E. WATER SYSTEM PROCEDURE

1. Adjust water systems, after air balancing, to obtain design flow rates.

2. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rate for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

3. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

4. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

5. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

6. Where available pump capacity is less than total flow requirements or individual system parts simulate full flow in one part by temporary restriction of flow to other parts.

3.4 TAB AGENCY TEST REPORT FORMS

A. Final report forms shall contain the following minimum data.

B. Report Forms

1. Title Page:
    a. Name of Testing, Adjusting, and Balancing Agency
    b. Address of Testing, Adjusting, and Balancing Agency
    c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
    d. Project name
    e. Project location
    f. Project Manager
    g. Project Inspector
    h. Project Contractor
    i. Project altitude
    j. Report date
2. Summary Comments:
    a. Design versus final performance
    b. Notable characteristics of system
    c. Description of systems operation sequence
    d. Summary of outdoor and exhaust flows to indicate building pressurization
    e. Nomenclature used throughout report
    f. Test conditions
3. Instrument List:
    a. Instrument
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Range
    f. Calibration date
4. Electric Motors:
    a. Manufacturer
    b. Model/Frame
    c. HP/BHP and kW
    d. Phase, voltage, amperage; nameplate, actual, no load
    e. RPM
    f. Service factor
    g. Starter size, rating, heater elements
    h. Sheave Make/Size/Bore

5. V-Belt Drive:
    a. Identification/location
    b. Required driven RPM
    c. Driven sheave, diameter and RPM
    d. Belt, size and quantity
    e. Motor sheave diameter and RPM
    f. Center to center distance, maximum, minimum, and actual
6. Pump Data:
    a. Identification/number
    b. Manufacturer
    c. Size/model
    d. Impeller size
    e. Service
    f. Design flow rate, pressure drop, BHP and kW
    g. Actual flow rate, pressure drop, BHP and kW
    h. Discharge pressure
    i. Suction pressure
    j. Total operating head pressure
    k. Shut off, discharge and suction pressures
    l. Shut off, total head pressure
7. Air Cooled Condenser:
    a. Identification/number
    b. Location
    c. Manufacturer
    d. Model number
    e. Serial number
    f. Entering DB air temperature, design and actual
    g. Leaving DB air temperature, design and actual
    h. Number of compressors
8. Chillers:
    a. Identification/number
    b. Manufacturer
    c. Capacity
    d. Model number
    e. Serial number
    f. Evaporator entering water temperature, design and actual
    g. Evaporator leaving water temperature, design and actual
    h. Evaporator pressure drop, design and actual
    i. Evaporator water flow rate, design and actual
    j. Condenser entering water temperature, design and actual
    k. Condenser pressure drop, design and actual

l. Condenser water flow rate, design and actual

9. Cooling Tower:
    a. Tower identification/number
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Rated capacity
    f. Entering air WB temperature, specified and actual
    g. Leaving air WB temperature, specified and actual
    h. Ambient air DB temperature
    i. Condenser water entering temperature
    j. Condenser water leaving temperature
    k. Condenser water flow rate
    l. Fan RPM
10. Heat Exchanger:
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Model number
    f. Serial number
    g. Steam pressure, design and actual
    h. Primary water entering temperature, design and actual
    i. Primary water leaving temperature, design and actual
    j. Primary water flow, design and actual
    k. Primary water pressure drop, design and actual
    l. Secondary water leaving temperature, design and actual
    m. Secondary water leaving temperature, design and actual
    n. Secondary water flow, design and actual
    o. Secondary water pressure drop, design and actual
11. Cooling Coil Data:
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Air flow, design and actual
    f. Entering air DB temperature, design and actual
    g. Entering air WB temperature, design and actual
    h. Leaving air DB temperature, design and actual
    i. Leaving air WB temperature, design and actual
    j. Water flow, design and actual

k. Water pressure drop, design and actual
l. Entering water temperature, design and actual
m. Leaving water temperature, design and actual
n. Saturated suction temperature, design and actual
o. Air pressure drop, design and actual

12. Heating Coil Data:

a. Identification/number
b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Water flow, design and actual
g. Water pressure drop, design and actual
h. Entering water temperature, design and actual
i. Leaving water temperature, design and actual
j. Entering air temperature, design and actual
k. Leaving air temperature, design and actual
l. Air pressure drop, design and actual

13. Electric Duct Heater:

a. Manufacturer
b. Identification/number
c. Location
d. Model number
e. Design kW
f. Number of stages and readings
g. Phase, voltage, amperage
h. Test voltage (each phase)
i. Test amperage (each phase)
j. Air flow, specified and actual
k. Temperature rise, specified and actual

14. Unit Ventilator and Fan Coil Data:

a. Manufacturer
b. Identification/number
c. Location
d. Model number
e. Size
f. Air flow, design and actual
g. Water flow, design and actual
h. Water pressure drop, design and actual
i. Entering water temperature, design and actual
j. Leaving water temperature, design and actual

k. Entering air temperature, design and actual
l. Leaving air temperature, design and actual

15. Air Moving Equipment:
    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Arrangement/Class/Discharge
    f. Air flow, specified and actual
    g. Return air flow, specified and actual
    h. Outside air flow, specified and actual
    i. Total static pressure (total external), specified and actual
    j. Inlet pressure
    k. Discharge pressure
    l. Sheave Make/Size/Bore
    m. Number of Belts/Make/Size
    n. Fan RPM
16. Return Air/Outside Air Data:
    a. Identification/location
    b. Design air flow
    c. Actual air flow
    d. Design return air flow
    e. Actual return air flow
    f. Design outside air flow
    g. Actual outside air flow
    h. Return air temperature
    i. Outside air temperature
    j. Required mixed air temperature
    k. Actual mixed air temperature
    l. Design outside/return air ratio
    m. Actual outside/return air ratio
17. Exhaust Fan Data:
    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Air flow, specified and actual
    f. Total static pressure (total external), specified and actual
    g. Inlet pressure
    h. Discharge pressure
    i. Sheave Make/Size/Bore

j. Number of Belts/Make/Size
k. Fan RPM

18. Duct Traverse:
    a. System zone/branch
    b. Duct size
    c. Area
    d. Design velocity
    e. Design air flow
    f. Test velocity
    g. Test air flow
    h. Duct static pressure
    i. Air temperature
    j. Air correction factor
19. Air Monitoring Station Data:
    a. Identification/location
    b. System
    c. Size
    d. Area
    e. Design velocity
    f. Design air flow
    g. Test velocity
    h. Test air flow
20. Flow Measuring Station:
    a. Identification/number
    b. Location
    c. Size
    d. Manufacturer
    e. Model number
    f. Serial number
    g. Design Flow rate
    h. Design pressure drop
    i. Actual/final pressure drop
    j. Actual/final flow rate
    k. Station calibrated setting
21. Terminal Unit Data:
    a. Manufacturer
    b. Type, constant, variable, single, dual duct
    c. Identification/number
    d. Location
    e. Model number
    f. Size

g. Minimum static pressure
h. Minimum design air flow
i. Maximum design air flow
j. Maximum actual air flow
k. Inlet static pressure

22. Air Distribution Test Sheet:

a. Air terminal number
b. Room number/location
c. Terminal type
d. Terminal size
e. Area factor
f. Design velocity
g. Design air flow
h. Test (final) velocity
i. Test (final) air flow
j. Percent of design air flow

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To clarify equipment included in sound and vibration measurements, consider adding a list to this paragraph.
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23. Sound Level Report:

a. Location
b. Octave bands - equipment off
c. Octave bands - equipment on
d. RC level - equipment on

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To clarify equipment included in sound and vibration measurements, consider adding a list to this paragraph.
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24. Vibration Test:

a. Location of points:
    1) Fan bearing, drive end
    2) Fan bearing, opposite end
    3) Motor bearing, center (when applicable)
    4) Motor bearing, drive end
    5) Motor bearing, opposite end
    6) Casing (bottom or top)
    7) Casing (side)
    8) Duct after flexible connection (discharge)
    9) Duct after flexible connection (suction)
b. Test readings:
    1) Horizontal, velocity and displacement
    2) Vertical, velocity and displacement

3) Axial, velocity and displacement

c. Normally acceptable readings, velocity and acceleration

d. Unusual conditions at time of test

e. Vibration source (when non-complying)

END OF SECTION

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Do not delete the following reference information.

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FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification Rev. 4, dated September 16, 2004.